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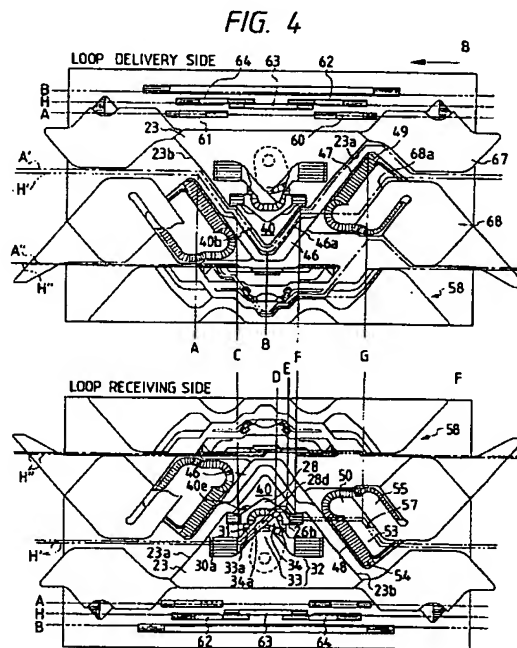
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(54) Knitting and transfer CAM for flat knitting machine

(57) A knitting cam for a knitting lock is provided which allows transfer of a loop using a needle of the type having a single butt for back and forth movement of the needle, wherein, by using only one movable cam for transfer selection, occurrence of trouble such as a failure in changing over in cam control which arises from employment of a plurality of movable cams is eliminated and use for a long period of time can be achieved.

At a location above a needle raising cam (23) having a loop receiving needle raising cam (32) in the inside thereof, a loop delivering needle raising cam (40) having a raising cam face (40a, 40b) continuous with a raising cam face (23a, 23b) of the needle raising cam (23) is mounted for movement into and out of an operative position, and a loop receiving needle lowering cam face (40d, 40e) having a loop receiving needle butt lowering locus continuous with a needle butt raising locus of the loop receiving needle raising cam (32) is formed along a lower edge of the loop delivering needle raising cam (40).



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## Description

This invention relates to a knitting cam for controlling back and forth movement of a compound needle having a single butt for back and forth movement of the needle, and more particularly relates to a knitting and transfer cam for a flat knitting machine which also performs transfer of a loop.

A knitting and transfer cam for a flat knitting machine for moving needles upwardly and downwardly between a knit position, a tuck position and a welt position in order to knit a knitted fabric and for operating the needles so as to transfer loops is known for example from Japanese Laid-Open Patent Application No. Heisei 4-2847.

In a lock having a cam as described above, at a location above a needle raising cam for raising a needle for knitting, a transfer raising cam for further raising a needle on the delivery side in transfer is provided, so that a needle on the delivery side is raised to a higher position than that adopted upon ordinary knitting. Meanwhile, a loop receiving side cam for raising a needle on the loop receiving side in transfer at such a timing that the needle on the loop receiving side is inserted into a loop of a knitted fabric which is raised to its highest position at the timing at which the needle on the delivery side is raised to its highest position and is held at a shoulder portion provided on the shank of the needle on the loop delivery side is provided in a central recessed portion of the needle raising cam.

Then, butt travel loci which extend along the cams are suitable changed over to perform ordinary knitting or transfer of loops. The changing over between the butt travelling loci is normally performed by suitable projection towards or retraction from an operative position of a cam located at a predetermined position. However, a plurality of movable cams are required for the changing over for ordinary knitting or for transfer of loops, and this means that the lock is complicated due to the arrangement of the movable cams.

Taking the foregoing into consideration, it is an object of the present invention to provide a knitting cam for a knitting lock which allows transfer of a loop using a needle of the type having a single butt for back and forth movement of the needle, wherein, by using only one movable cam for transfer selection, occurrence of trouble such as a failure in changing over in cam control which arises from employment of a plurality of movable cams is eliminated and use for a long period of time can be achieved.

This is achieved in accordance with the invention by a knitting and transfer cam for a flat knitting machine, wherein, at a location above a needle raising cam having a loop receiving needle raising cam in the inside thereof, a loop delivering needle raising cam having a raising cam face continuous with a raising cam face of the needle raising cam is mounted for movement into and out of an operative position, and a loop receiving

needle lowering cam face having a loop receiving needle butt lowering locus continuous with a needle butt raising locus of the loop receiving needle raising cam is formed along a lower edge of the loop delivering needle raising cam.

The loop receiving needle raising cam provided in a recessed portion in the inside of the needle raising cam may comprise a fixed cam and a rockable cam.

Furthermore, in a preferred embodiment, along a lower edge of a needle raising cam top element which faces a concave portion provided at the centre of the needle raising cam, an inclined face continuous with the recessed portion is provided, and the needle raising cam top element is formed as a half height element while a loop delivering raising cam is formed with full height such that a loop receiving needle butt which has been raised along a loop receiving needle raising locus extending along the loop receiving needle raising cam passes the needle raising cam top element and is engaged by the loop receiving needle lowering cam face on the lower edge of the loop delivering needle raising cam so as to be introduced into the loop receiving needle butt lowering locus.

In order to perform ordinary knitting of a knit stitch using the knitting cam mechanism of the present invention, the loop delivering needle raising cam is retracted to its inoperative position while the needle raising cam top element is formed as a cam which can raise a needle to its highest position so that a needle to form a loop is first raised to its highest position by the needle raising cam and the needle raising cam top element and is then lowered by the knitting cam while it receives, in the hook thereof, a yarn supply and draws out the supplied yarn through an old loop to form a new loop.

In order to knit a tuck stitch, when a butt comes to the top portion of the needle raising cam before it is raised to the needle raising cam top element, the butt is sunk by a presser so that the butt subsequently passes the top portion of the needle raising cam without engaging with the needle raising cam top element and is then lowered by the knitting cam. Accordingly, the amount of rise of the needle is smaller, and a supplied yarn in the last course held by the hook is not knocked over. Since a yarn for formation of a new loop is further supplied into the hook, if the sequence is repeated, then a plurality of supplied yarns are held in the hook. Then, if the needle butt is subsequently raised to the top portion of the needle raising cam top element similarly as upon knitting of a knit stitch and is then lowered by the knitting cam, then a new loop is drawn out through loops of all supplied yarns already held in the hook, thereby forming a tuck loop.

A higher density tuck stitch which has a smaller loop length than the tuck stitch described above is knitted in the following manner. Upon formation of a tuck stitch described above, the presser acts, when a butt having passed the top portion of the needle raising cam comes to the knitting cam, to push the butt into a corresponding

needle groove so that the butt jumps the lowering cam face of the knitting cam without engaging with the same. The butt is then engaged by the lowering cam face of the fixed cam located in the inside of the knitting cam so that it is lowered by the lowering cam face of the fixed cam. Since the most lowered position of the butt then is higher than the most lowered position by the knitting cam, a new loop thus produced is a higher density loop which is smaller than a loop formed by the knitting cam.

Transfer of a loop is performed in the following manner. Transfer of a loop is performed with the loop delivering needle raising cam positioned in its operative position. A needle on the loop delivery side is raised to its highest position, and the hook in an open condition of a receiving side needle is inserted into a loop held at a stepped portion of the needle at which a blade is provided. Thereafter, the loop delivery side needle and then the receiving side needle are lowered, whereupon the delivery side needle moves out of the loop while the loop is received in the hook of the receiving side needle, thereby completing transfer of the loop.

In particular, while the needle butt on the loop delivery side is raised to its highest position by the needle raising cam and the loop delivering needle raising cam, the butt of the loop receiving side needle jumps the needle raising cam and is raised to a position around its tuck position by the loop receiving needle raising fixed cam and the rockable cam in the needle raising cam. As a result of the rising movement, the loop receiving side needle inserts its hook into the blade of the loop delivery side needle to thus insert the hook into the loop held at the stepped portion of the loop delivery side needle. Then, the loop receiving side needle is lowered a little by the loop receiving needle lower cam face provided on the lower edge of the transfer raising cam, whereafter the needle butt is pushed in by an action of the presser. The needle butt thus pushed in jumps the raising cam face of the needle raising cam and the lowering cam face of the knitting cam and then is engaged by the lowering cam face of the fixed cam in the inside of the knitting cam so that it is lowered to the height of the original position after a delay from the loop delivery side. During this operation, the loop delivery side needle continues to be lowered until it comes to the lowermost position of the knitting cam delivering its loop to the hook of the loop receiving side needle.

In order to perform intermediate split knitting (increase of a stitch), when the butt of the loop delivering needle is lowered to the tuck position, the butt is pushed in by the presser so that it thereafter jumps the lowering cam face of the knitting cam and enters the concave portion in the inner face of the knitting cam, in which it passes substantially horizontally, whereafter it is lowered to the height adopted upon starting by the lowering cam face of the fixed cam. During the operation, on the loop receiving side, similarly as upon transfer of a loop described above, the needle butt is first lowered by the loop receiving needle lowering cam face on the lower face of

the loop delivering needle raising cam and then jumps, by an action of the presser, the raising cam face of the needle raising cam and the lowering cam face of the knitting cam and moves generally horizontally in the recessed portion in the inner face of the knitting cam. A loop is held in the hooks of both of the needles on the loop delivery side and the loop receiving side. Then, the two needles are both lowered to the same height positions as those upon starting along the fixed cam faces.

An example of an embodiment of a cam in accordance with the present invention will now be described by way of example and with reference to the accompanying drawings. In the drawings:

Fig. 1 shows an embodiment of the present invention and is an arrangement view of a cam lock of a carriage as viewed from below showing the travel loci of a butt upon transfer of a loop and intermediate increase of a loop;

Fig. 2 is a side elevational view of a needle, a select jack, a selector and so forth;

Fig. 3 shows the embodiment of the present invention and is a cam arrangement view of the cam lock of the carriage as viewed from below showing the travel loci of a butt upon knitting of a knit stitch, a tuck stitch and a welt stitch; and,

Fig. 4 is a cam arrangement view showing the travel loci of a butt upon transfer of a loop and intermediate increase of a loop.

A carriage in which a cam 1 of the present invention is incorporated is shown as viewed from the lower face side in Figs. 1 and 3, and a side elevation of a needle 2 and so forth operated by a cam lock of the carriage is shown in Fig. 2.

The cam 1 of the present invention is provided for use with a needle 2 of the one-butt type. In the example shown, the needle 2 is of the type wherein a needle jack 4 is engaged with a needle body 3, and a single needle butt 5 is provided on the needle jack 4. A slider 7 is inserted on an upper edge of an end of the needle body 3 for fitting sliding movement in a channel-shaped portion of the needle jack 4 so that, when a slider butt 8 is operated, a hook 9 of the needle body 3 can be opened or closed by a forward end portion of the slider 7. A head portion of a select jack 10 is engaged with an upper portion of a tail portion of the needle jack 4, while a head portion of a selector 11 is engaged with the select jack 10.

The needle body 3, needle jack 4, select jack 10 and selector 11 are inserted and supported for sliding movement in each of needle grooves of a needle bed (not shown). The select jack 10 has recesses 12, 13 and 14 formed along a lower edge of a tail portion thereof. A wire 15 extending through the needle bed in a direction perpendicular to the needle grooves in which the needles 2, select jacks 10 and so forth are inserted and supported is engaged in one of the recesses 12, 13 and

14 to define the position of the butt 16 of the select jack 10 in the needle groove. When the wire 15 is engaged in the recess 12, 13 or 14, the butt 16 of the select jack 10 is positioned at an A position, an H position or a B position, respectively.

A cam arrangement of a lock 21 will now be described. The cam 1 of the present invention for performing knitting and transfer of loops is arranged at the centre of the lock. A needle raising cam 23 provided on a base plate 22 at the position of the centre of the lock 21 has a trapezoidal shape having a pair of raising cam faces 23a and 23b on the left and right sides thereof and has a pair of downwardly inclined faces 26a and 26b provided at a top portion thereof and extending parallel to the direction of movement of the carriage such that they are inclined towards the centre of the cam. A needle raising cam top element 28 of gate shape and of half height is positioned between the inclined faces 26a and 26b, and has a pair of triangular raising cam faces 28a and 28b at a top portion thereof and has an inclined face 28d formed along a bottom edge thereof and defining a recessed portion 28c therein.

The needle raising cam 23 is formed from a single part including the needle raising cam top element 28. In order to work the needle raising cam in such a shape that the inclined face 28d on the lower edge of the needle raising cam top element 28 encroaches upon the needle raising cam top element 28, some extension must be left at a flat portion of the needle raising cam top element 28 at the extremity of the inclined face 28d, and to this end the width of the top portion in a horizontal direction to be jumped upon knitting of a tuck stitch is greater than that of a conventional raising cam. Although a construction of the needle raising cam 23 and of the needle raising cam top element 28 from separate parts can decrease the range over which a needle butt must jump by an action of a tuck presser, such a structure as described above is used in the present invention in order to reduce the number of parts.

A pair of downwardly inclined faces 30a and 30b inclined towards the centre are provided parallel to the direction of movement of the carriage on the inner sides of central portions of the raising cam faces 23a and 23b of the needle raising cam 23 respectively, and a loop receiving side needle raising cam 32 is provided between the inclined faces 30a and 30b. The loop receiving side needle raising cam 32 is composed of a loop receiving side needle raising fixed cam 33 of a mountain shape having a pair of raising cam faces 33a and 33b on the opposite side thereof, and a loop receiving side needle raising rockable cam 34 having a pair of cam faces 34a and 34b of a mountain shape and supported for rocking motion around a pivot 35. The loop receiving side needle raising rockable cam 34 is provided in an overlapping condition with the loop receiving side needle raising fixed cam 33 in a concave portion 31 continuous with the inclined faces 30a and 30b. The loop receiving side needle raising rockable cam 34 has a top

portion projecting as a triangular shape from the top portion of the loop receiving side needle raising fixed cam 33 until it is positioned within the recessed portion 28c of the needle raising cam top element 28 such that, when the loop receiving side needle raising rockable cam 34 is rocked to the right in Fig. 1, the raising cam face 34a is aligned with the raising cam face 33a of the needle raising cam 23, but when the loop receiving side needle raising rockable cam 34 is locked to the left, the raising cam face 34b is aligned with the raising cam face 33b of the needle raising cam 23. The top portion of the rockable cam 34 extends fully from the base plate 22 similarly to the needle raising cam 23.

A loop delivering needle raising cam 40 is provided at a location above the needle raising cam top element 28. The loop delivering needle raising cam 40 has a mountain shape having a pair of raising cam faces 40a and 40b on the left and right sides thereof and has a concave portion 40c formed along a lower edge thereof such that it accepts a top portion of the needle raising cam top element 28 therein. The loop delivering needle raising cam 40 has a pair of half thickness portions 40f and 40g having lowering cam faces 40d and 40e on the left and right sides of the concave portion 40c respectively. The loop delivering needle raising cam 40 is supported such that it is projected to or retracted from a full position in a vertical direction by suitable means. A pair of shoulder portions 44a and 44b are formed along a lower side of the cam 40 such that the width of the lower side of the cam 40 is a little narrower than the width of the top portion of the needle raising cam 23, but the raising cam face 23a of the needle raising cam 23 and the raising cam face 40a of the loop delivering needle raising cam 40 are continuous with each other. A guard cam 46 is provided in such a position that it surrounds a top portion of the loop delivering needle raising cam 40 with a butt path 45 left therebetween.

A pair of knitting cams 49 and 50 having lowering cam faces 47 and 48 opposed to the raising cam faces 23a and 23b of the needle raising cam 23 are mounted for upward and downward movement with butt paths 51 and 52 left therebetween. Since the knitting cams 49 and 50 have a symmetrical structure to each other, only the knitting cam 50 will be described.

While the knitting cam 50 has the lowering cam face 48 formed from a face opposed to the raising cam face 23b of the needle raising cam 23, a central portion thereof is formed as a very thin concave portion 53, and an inclined face 54 is formed from a portion of the knitting cam 50 positioned a little inwardly from the lowering cam face 48 towards the concave portion 53.

Further, a guide cam 56 having an extension 55 extending into the concave portion 53 of the knitting cam 50 is provided at a fixed position adjacent to the knitting cam 50. The knitting cam 50 is supported on the base plate 22 for movement in the direction of the lowering cam face 48 by a member which is not shown. One side of the extension 55 forms a lowering cam face 57 for

knitting a higher density tuck stitch, for a loop receiving needle and for intermediate stitch increase. The lowering cam face 57 extends parallel to the lowering cam face 48 for loop formation of the knitting cam 50.

A slider guide cam 58 for engaging with the slider butt 8 to operate the slider 7 for the needle 2 is provided at the centre of the lock 21 above the guard cam 46. In connection with the slider guide cam of Figs. 1 and 3, each cam denoted at H is a cam of half height, and each cam denoted at F is a cam of full height.

A pair of A position pressers 60 and 61 are provided at positions below the needle raising cam 23 on a locus along which the butt 16 of the select jack 10 moved to the A position by the selector 11 moves, and three pressers 62, 63 and 64 are provided at positions on another locus along which the butt 16 selected to the H position by the selector 11 moves. A presser 65 is provided at a position on a further locus along which the butt 16 selected to the B position moves. Each of the pressers 60, 61 and 63 assumes, in an inoperative condition, a respective upwardly rocked position as shown in Fig. 1, while each of the pressers 62 and 64 assumes a downwardly rocked position, and the presser 65 is fixed. It is to be noted that the pressers 60 to 64 may be constructed so as not to be rocked but to be sunk.

While the presser 63 sinks a needle jack butt corresponding to a needle butt which is to jump the needle raising cam top element 28 as described hereinabove, since the jumping width is great as described above, the presser 63 also has a great length so as to cover the extent of the width. Consequently, the opposite ends of the presser 63 must be arranged in an overlapping relationship with the end portions of the pressers 62 and 64 positioned on each side of the presser 63 and are thus arranged as in the embodiment.

Methods of knitting a knitted fabric will now be described.

While methods of forming a knit stitch, a tuck stitch and a miss stitch are described with reference to Fig. 3, upon knitting of the stitches, the loop delivering needle raising cam 40 is sunk to an inoperative position.

The operation of knitting a knit stitch will now be described.

It is assumed that, upon knitting of a knitted fabric, the carriage moves in the direction indicated by the arrow in Fig. 3. Selection of the needles 2 to the knit, tuck and welt positions upon knitting is performed by known means, and those select jack butts 16 which correspond to those needles to be raised to the knit position are positioned at the A position. In this instance, the pressers 60 and 61 are positioned to their respective inoperative positions so that they may not act upon the select jack butts 16. Consequently, as seen from a locus A' in Fig. 3, the needle butt 5 of each of those needles is engaged with the raising cam face 23a of the raising cam 23 and is raised along the cam face 23a. In this instance, since the loop delivering needle raising cam 40 is in its sunk position, the needle butt 5 having been raised along the

cam face 23a then moves horizontally relative to the carriage remaining at the position of the shoulder 44a of the needle raising cam 23, whereafter it is raised to its highest position by the needle raising cam top element 28. Then, the needle receives a yarn supply from a yarn feed (not shown), and then as the carriage moves further, the needle butt 5 is engaged with and lowered by a lowering cam face 46b of the guard cam 46. Thereafter, the needle butt 5 is lowered to its lowermost position by the lowering cam face 48 while forming a needle loop from the supplied yarn. The needle butt 5 having been lowered to its lower end position is then raised to the height of the original position by a guide cam 66.

During the upward and downward movements of the needle 2, the slider butt 8 follows another locus A" wherein it is first raised by the slider cam 58 after a delay of the raising movement of the needle body 3 to open the hook 9 and then lowered by the slider guide cam 58 after a delay of the lowering movement of the needle body 3 to close the hook 9. The loci of the needle butt 5 and the slider butt 8 are each indicated by a single-short, single-long broken line.

The operation of knitting a tuck stitch will now be described.

The select jack butt 16 corresponding to each needle to perform knitting of a tuck stitch is positioned to the H position by an action of the selector 11. Then, the presser 63 at the H position is positioned to its operative position while the other pressers 62 and 64 at the H position are positioned to their respective inoperative positions.

If it is assumed that the carriage moves in the direction of the arrow in Fig. 3, the select jack butt 16 and the needle 5 move from the left to the right relative to the carriage following loci H, H' represented by double-short, single-long lines in Fig. 3. In this instance, since the pressers 62 and 64 are in their inoperative positions and the presser 63 is in its operative position, the needle butt 5 is raised along the raising cam face 23a of the needle raising cam 23 and then moves horizontally relative to the carriage from the shoulder portion 44a. Here, since the select jack butt 16 is pushed in by the presser 63, the needle butt 5 of the needle 2 corresponding to the select jack 10 is pushed in the corresponding needle groove, and consequently the needle butt 5 is not engaged by the needle raising cam top element 28 and accordingly moves horizontally succeeding the shoulder portion 44a without being raised along the raising cam face 28a of the needle raising cam top element 28. During the movement, the needle 2 receives in the hook 9 thereof a new yarn supply with a previous loop or loops held therein. Thereafter, the needle butt 5 is engaged by and lowered by the lowering cam face 48 of the knitting cam 50 so that it thereafter follows the locus H' shown by a double-short, single-long line, in a similar way to the knitting of a knit stitch. During the movement, the slider 7 follows the locus H' shown by a double-short, single-long line in which the slider butt 8 is moved up-

wardly and downwardly by the slider guide cam 58 to open and close the hook 9 of the needle 2.

A higher density tuck stitch wherein the size of a knitted loop is comparatively small is formed in the following manner.

Upon such knitting of a tuck stitch as described above, when the needle butt 5 having been sunk by the presser 63 and passed without engaging with the needle raising cam top element 28 is engaged by the lowering cam face 48 of the knitting cam 50, if the presser 64 is positioned at its operative position so that the butt 16 is pushed into the corresponding needle groove by the presser 64, then the needle butt 5 jumps the lowering cam face 48 of the knitting cam 50 along a locus indicated by a broken line. Thereafter, the needle butt 5 is lowered along the inclined face 54 and enters the concave portion 53 of the knitting cam 50, whereafter it is engaged by the lowering cam face 57 formed on the extension 55 of the guide cam 56. The needle butt 5 is lowered to its lowermost position by the lowering cam face 57.

The lowermost position is higher than the position to which the needle butt 5 is lowered otherwise by the lowering cam face 48 of the knitting cam 50. Consequently, a loop formed by the needle 2 is smaller in size than a loop which is formed by an action of the knitting cam 50, and accordingly, the loop formed is a loop of a higher density tuck stitch. Such stitch is used, for example, for the knitting of a boundary portion of an intarsia knitted fabric and so forth. The needle butt 5 lowered to the lowermost position by the guide cam 56 enters, as the carriage advances, into the ordinary tuck locus indicated by a double-short, single-long line.

When the welt position from which a needle 2 is not raised is adopted, the select jack butt 16 is selected to the B position by the selector 11. Since the presser 65 is fixed and always assumes an operative position, when the carriage moves, the select jack butt 16 is pushed in by the presser 65 so that also the needle butt 5 is sunk into the corresponding needle groove. Consequently, the needle butt 5 and the slider butt 8 are engaged by none of the cams of the lock 21, but pass the positions B' and B", and the needle 2 does not act at all.

Transfer of a loop will now be described.

In order to perform transfer of a loop, as shown in Fig. 1, at least on the needle bed on the loop delivery side, the loop delivering needle raising cam 40 is projected fully to its operative position. Then, a loop is transferred from a needle on one of the two beds raised by the loop delivering needle raising cam 40 on the carriage to another needle on the other bed raised by the loop receiving side needle raising cam 32 on the carriage.

Transfer of a loop wherein a loop is transferred from a needle on the needle bed for the rear side carriage B to another needle of the needle bed for the front side carriage F shown at a lower location in Fig. 4 will now be described with reference to Fig. 4.

It is to be noted that the front and rear carriages F

and B move in the direction indicated by the arrow from the right to the left in Fig. 4. A loop delivering select jack butt is selected to the A position while a loop receiving select jack butt is selected to the H position.

If the carriages are moved in the direction of the arrow with the select jack butt 16 of the loop delivery side needle 2 selected to the A position and with the pressers 60 and 61 of the A position set to the respective inoperative positions, then the needle butts 5 are raised, without being acted upon by the pressers 60 and 61, to the uppermost positions along the raising cam face 23b of the needle raising cam 23 and the raising cam face 40b of the loop delivering needle raising cam 40 and then are lowered along the lowering cam faces 46a and 47 of the quard cam 46 and the knitting cam 49, whereafter they are guided to the original height positions by a guide cam 67, respectively, as indicated by single-short, single long lines in Fig. 4. The loci are denoted at A' in Fig. 4.

Each delivery side needle butt 5 having followed the locus of the line A' described above, after passing the A position in Fig. 4, is engaged by and is thereafter raised along the raising cam face 23b of the needle raising cam 23. However, the slider butt 8 advances straightforwardly relative to the carriage B as indicated by A" also after passing the A position. Consequently, the slider 7 assumes a lower position with respect to the needle body 3, and consequently the hook 9 is put into an open condition. Keeping this condition, the loop delivery side needle butt 5 is raised along the raising cam face 23b of the needle raising cam 23. As the needle butt 5 rises, a loop which has been held in the hook leaves the hook and is stopped by a stepped portion 18 in the proximity of a blade 17 in a condition wherein it surrounds the spring. Thereafter, the needle 2 is continuously raised to its highest position along the loop delivering needle raising cam 40 (the B position in Fig. 4).

In the meantime, on the carriage F side, since the pressers 62 and 64 are positioned in their respective operative positions and the presser 63 is positioned in its inoperative position, the needle butt 5 of the receiving side needle 2 is pushed into the corresponding needle groove as the select jack butt 16 of the needle 2 is pushed in by the presser 62 in the operative position immediately before the needle butt 5 is engaged by the raising cam face 23a of the needle raising cam 23. Consequently, the needle butt 5 jumps the raising cam face 23a of the needle raising cam 23 without engaging with the same. Thereafter, the needle butt 5 is lowered along the inclined face 30a and enters the concave portion 31 in the needle raising cam 23, whereafter it is engaged by the raising cam face 33a of the loop receiving side needle raising fixed cam 33 (the C position in Fig. 4) so that it is raised along the raising cam face 33a. Then, the needle butt 5 is engaged by and raised by the cam face 34a of the loop receiving side needle raising rockable cam 34 (the D position of Fig. 4). Upon such rising movement, the receiving side needle inserts the hook 9

thereof into the blade 17 (shown in Fig. 2) provided on a side face of the delivery side needle and hence into the loop held on the stepped portion 18. After passing the D point, the loop receiving side needle butt is raised by the inclined face 28d of the needle raising cam top element 28 of half height, passes the needle raising cam top element 28 and is then engaged by the lowering cam face 40e on the lower edge of the loop delivering needle raising cam 40 (the E position in Fig. 4). Thereafter, the loop receiving side needle butt is lowered along the lowering cam face 40e until it enters the inclined face 26b (the F position in Fig. 4).

The needle butt 5 having entered the inclined face 26b rides over the inclined face 26b and is disengaged from the needle raising cam 23 as the carriages advance. Thereupon, the select jack butt 16 is pushed by the presser 64 again. Consequently, the needle butt 5 jumps the raising cam face 23b of the needle raising cam 23 and the lowering cam face 48 of the knitting cam 50 and enters the concave portion 53, in which it moves horizontally relative to the carriage, keeping its height until it is engaged by the lowering inclined face of the extension 55 of the guide cam 56 (the G position in Fig. 4). Meanwhile, the loop delivery side needle has been lowered to the receiving side needle by the lowering cam face 46a of the guard cam 46 while closing the hook thereof to start the escape therefrom of the loop to be transferred. Then, the loop delivery side needle butt 5 having been lowered along the lowering cam face 46a of the guard cam 46 is further lowered by the lowering cam face 47 of the knitting cam 49, whereupon the needle escapes from the loop which has been held thereon so that the loop remains on the hook of the receiving side needle (the G position in Fig. 4). Then, also the loop receiving needle is lowered by the lowering cam face 57 of the extension 55 of the guide cam 56. In this instance, while the slider butt of the loop receiving side needle is lowered a little by the slider guide cam 58, since the amount of the lowering movement of the needle by the needle butt is larger, the hook is closed after it receives the loop, and the needle receiving side needle returns to its original height with the hook closed.

When slip knitting (intermediate increase of a stitch) is to be performed, the travel locus of a loop receiving side needle is the same as that upon transfer of a loop. The travel loci of the needle butt and of the slider butt on the loop delivery side are denoted by H' and H" respectively. The loop delivering needle passes the top portion of the loop delivering needle raising cam 40 and is lowered along the lowering cam face 46a of the guard cam 46. Then, when the needle butt 5 comes to the position (the F position of Fig. 4) at the lowermost portion of the cam face 46a, the presser 62 acts to push in the needle butt 5 so that the needle butt 5 thereafter moves horizontally relative to the carriage B. Consequently, the hook of the loop delivery side needle cannot escape from a loop which has been held thereon, and while the loop remains held on the hook of the loop delivering nee-

dle, it is held also on the hook of the receiving side needle. Then, the needle butt 5 jumps the lowering cam face 47 of the knitting cam 49 so that it is guided into the recess in the knitting cam 49, whereafter it is lowered by a lowering cam face 68a of a fixed cam 68. During the operation, in the locus after passing the E point, the loop is held on the hooks of both the delivery side and the receiving side.

Since the cam lock of the present invention is constructed such that only a loop delivering needle raising cam for transfer selection is formed as a movable cam mounted for movement into and out of an operative position so that a loop delivering needle is raised and a loop receiving needle is lowered by the cam, occurrence of trouble such as a failure in changing over in cam control which arises from use of a plurality of movable cams is eliminated and the cam lock can withstand use for a long period of time.

## Claims

1. A knitting and transfer cam for a flat knitting machine, wherein, at a location above a needle raising cam (23) having a loop receiving needle raising cam (32) in the inside thereof, a loop delivering needle raising cam (40) having a raising cam face (40a, 40b) continuous with a raising cam face (23a, 23b) of said needle raising cam (23) is mounted for movement into and out of an operative position, and a loop receiving needle lowering cam face (40d, 40e) having a loop receiving needle butt lowering locus continuous with a needle butt raising locus of said loop receiving needle raising cam (32) is formed along a lower edge of said loop delivering needle raising cam (40).
2. A knitting and transfer cam for a flat knitting machine as claimed in claim 1, characterised in that said loop receiving needle raising cam (32) provided in a recessed portion in the inside of said needle raising cam (23) comprises a fixed cam (33) and a rockable cam (34).
3. A knitting and transfer cam for a flat knitting machine as claimed in claim 1 or 2, characterised in that, along a lower edge of a needle raising cam top element (28) which faces a concave portion provided at the centre of said needle raising cam (23), an inclined face (28d) continuous with said recessed portion is provided while the loop delivering raising cam (40) is provided at a location above said needle raising cam top element (28) such that a loop receiving needle butt (5) which has been raised along said loop receiving needle raising cam (23) provided in said concave portion passes a top portion of said loop receiving needle raising cam and is engaged by said loop receiving needle lowering cam

face (40d, 40e) on the lower edge of said loop delivering needle raising cam (40) so as to be introduced into said loop receiving needle butt lowering locus.

4. A knitting and transfer cam for a flat knitting machine as claimed in claim 1, 2 or 3, characterised in that a presser (63) for jumping a needle butt (5), which is going to pass said needle raising cam top element (28), is provided at a location below the centre of said needle raising cam (23) while another presser (62, 64) for jumping the needle butt to jump said raising cam face (23a, 23b) of said needle raising cam (23) and said lowering cam face of a knitting cam (49, 50) is provided such that end portions thereof are positioned on one select jack butt travel locus in an overlapping relationship with the opposite sides of the first mentioned presser (63).

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FIG. 1

- - - - - TR DELIVERY  
 - - - - - TR DELIVERY (INTERMEDIATE INCREASE OF STITCH)  
 - - - - - TR RECEIVING

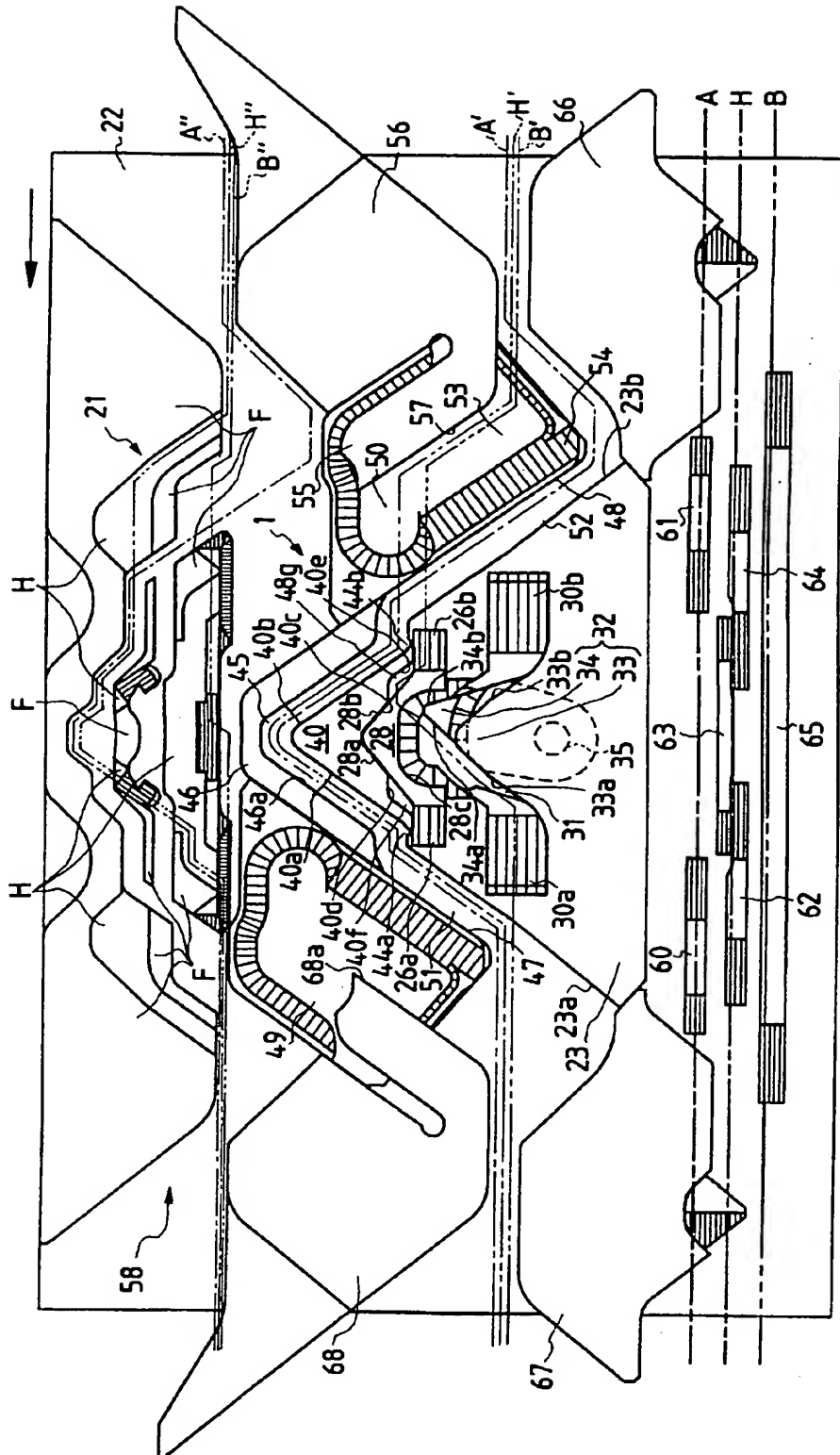


FIG. 2

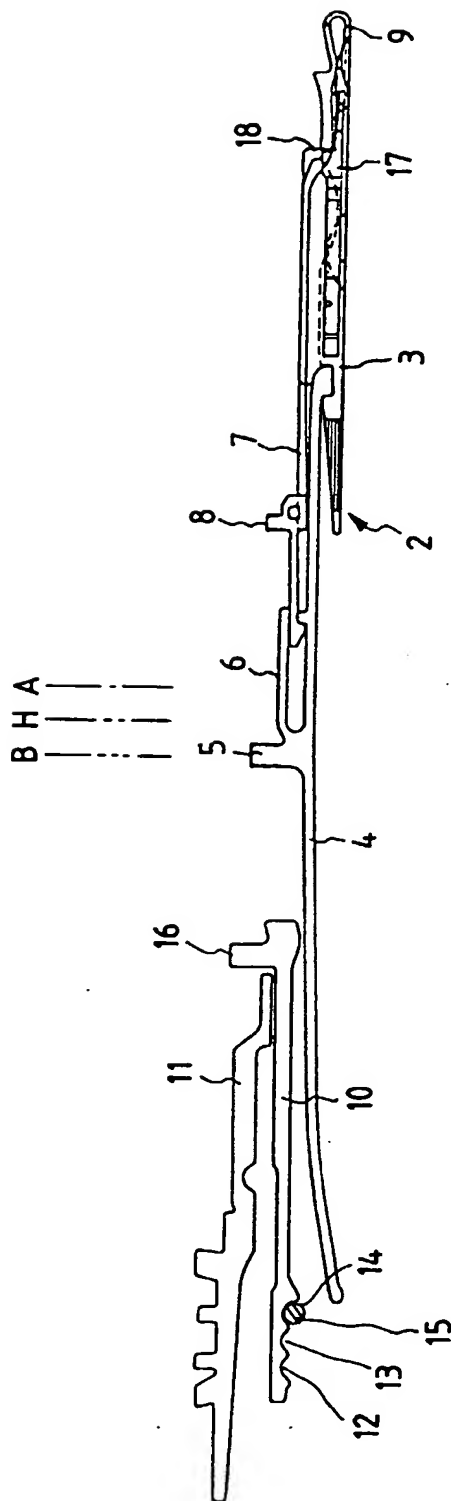


FIG. 3

TUCK ——— KNIT  
 MISS - - - -  
 HIGHER DENSITY TUCK - - - -

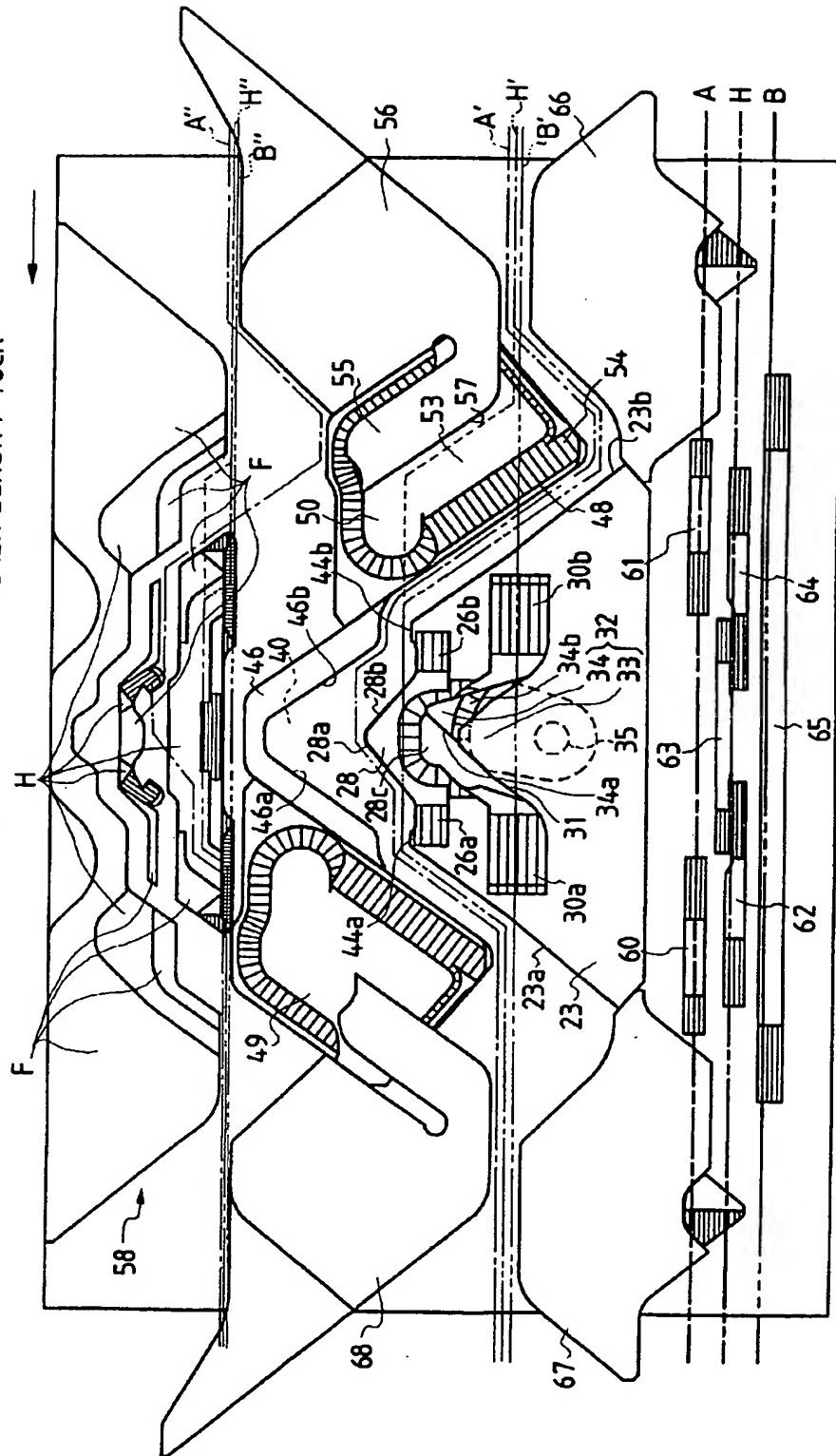
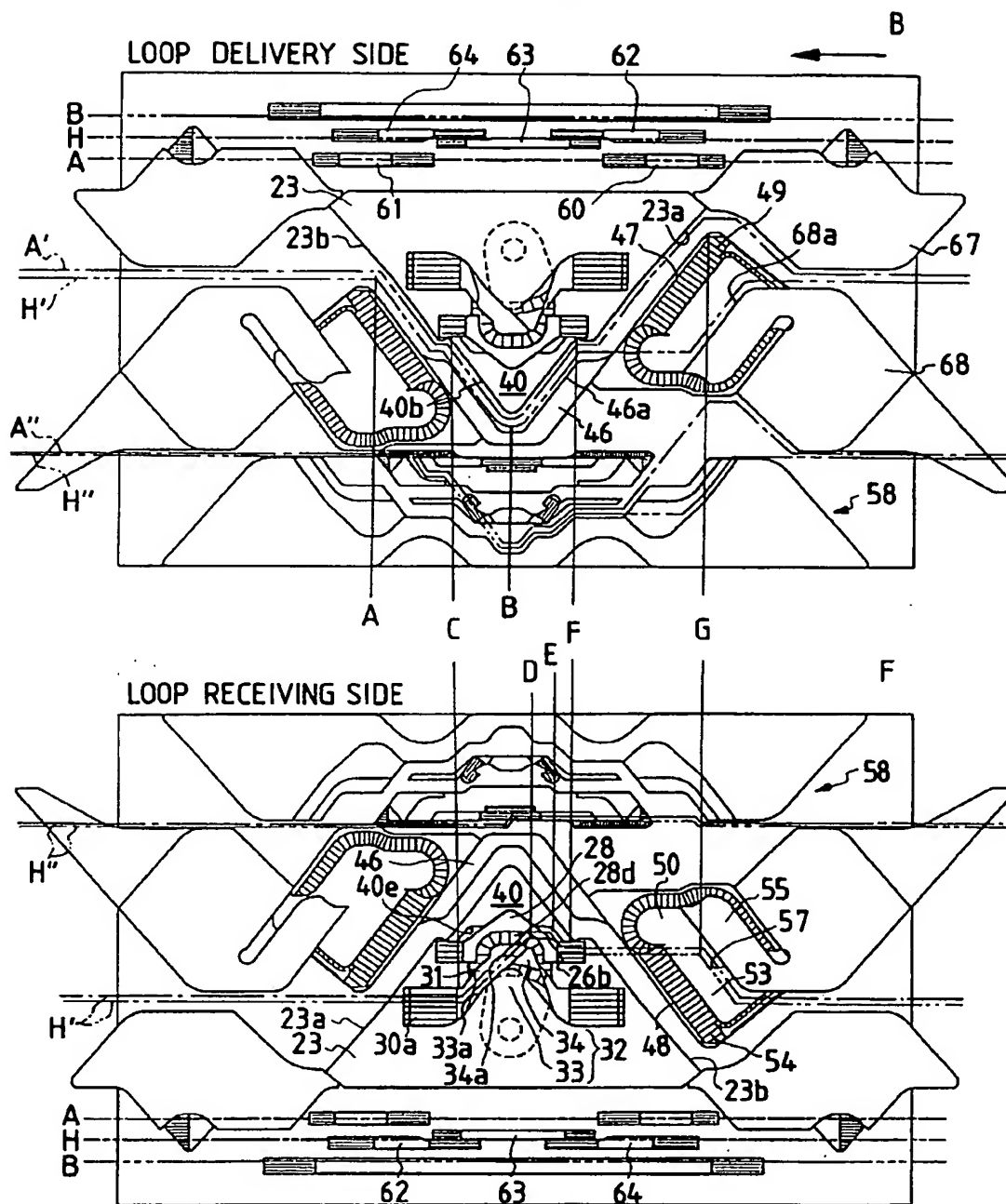


FIG. 4





European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 96 30 4755

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                      |                                                    |                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Citation of document with indication, where appropriate, of relevant passages        | Relevant to claim                                  | CLASSIFICATION OF THE APPLICATION (Int.Cl.6)     |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | US-A-4 637 227 (SHIMA)<br>---                                                        |                                                    | D04B15/36                                        |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EP-A-0 535 985 (SHIMA SEIKI MFG., LTD.)<br>---                                       |                                                    |                                                  |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | GB-A-2 177 427 (UNIVERSAL MASCHINENFABRIK DR. RUDOLPH SCHIEBER GMBH & CO. KG)<br>--- |                                                    |                                                  |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | GB-A-2 164 363 (H. STOLL GMBH & CO.)<br>-----                                        |                                                    |                                                  |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                      |                                                    | TECHNICAL FIELDS SEARCHED (Int.Cl.6)<br><br>D04B |
| Place of search<br>THE HAGUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                      | Date of completion of the search<br>3 October 1996 | Examiner<br>Van Gelder, P                        |
| <p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone<br/> Y : particularly relevant if combined with another document of the same category<br/> A : technological background<br/> O : non-written disclosure<br/> P : intermediate document</p> <p>T : theory or principle underlying the invention<br/> E : earlier patent document, but published on, or after the filing date<br/> D : document cited in the application<br/> I : document cited for other reasons<br/> &amp; : member of the same patent family, corresponding document</p> |                                                                                      |                                                    |                                                  |

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